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Inside . . .

Airtightness of building envelopes is getting more attention. Air leakage can happen in many places. But just significant are the various details we dwell on? We present the findings of a study that looked at alternate ways of air sealing joist headers, electric outlets and windows. We also review a study that measured airtightness over a period of time, and found that the construction stands up over time.

Do people know what ventilation does and how their ventilation system should be operated? We present interesting findings of a study of a group of Winnipeg houses.

EMR/CANMET News presents updates on three more Advance House Projects.

Other items include a product review of a new ventilation system duct fitting, Passive solar design software review, TRC news, and more.

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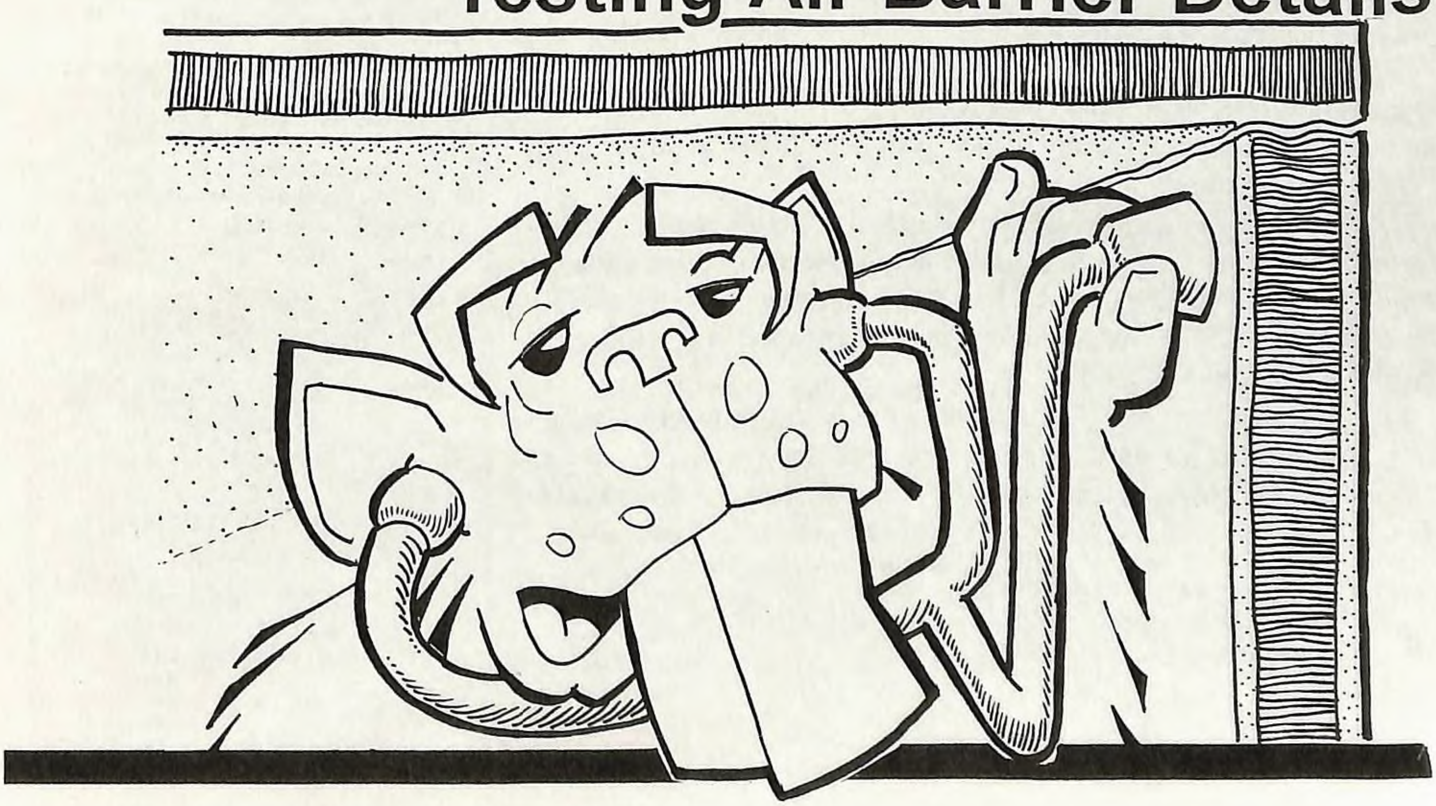

From the Publisher . . .

We are, without a doubt, among the best housed people in the world. We tell ourselves continuously about the better quality home that we build today. But are we kidding ourselves?

Is there no room to improve? Can we sit back and relax on our laurels? If we look around a typical new home today, there are many items that raise doubts about the quality of what we build. Why is it that so much effort goes into the surface look of fixtures, cabinets, or whatever, and not into the more substantive concerns about lasting quality? What good is an impressive looking finish that is only skin deep, on a base of third rate materials that will deteriorate in a short time?

Have we talked ourselves into believing what we want? Maybe our expectations and reality are two separate issues.

What got me thinking about how we view quality was when I discovered how the manufacturer finished a mail slot in a new insulated door: the slot was cut out of the door, brass trim installed on the outside and inside of the door, but the slot was not lined with any form of rigid material. We know that over time the rigid insulation will wear down and crumble into dust over time, especially as there is going to be material rubbed against the opening. The builder could only tell me that "they always make them that way".

It may seem like a small issue to quibble about, but it is a reflection of how we tolerate poor quality as long as it looks good for a while (at least past the warranty period).

Good design, and good quality reflect a process that dwell on the little details that contribute to better lasting goods. Just think about where the best quality products originate - be they a simple kitchen appliances or utensils, tools or automobiles.

We appreciate the quality of a well designed products, that too often originate in Europe, Japan and only occasionally North American. Why? Simply because they are thought through to the smallest detail, and it doesn't have to cost more, and in fact may be cheaper. The same can apply to the houses we build.

But if we are to see more better quality products, we must insist on them. Manufacturers must be persuaded that sloppy, shoddy cheap products are not good enough. I know it may not be easy at first, but if enough requests are made, they will start to respond.

Richard Kadulski,
Publisher

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Air Barrier Details: how effective are they?

Airtightness of building envelopes has received much attention recently. Air leakage usually happens at joints or connections between materials, or where there are penetrations for services rather than through the materials themselves.

Do some details work better than others? To find out the answer, CMHC commissioned a project to measure the air leakage of three typical details in wood-frame walls: the header joist, electric outlets, and window openings. Three construction methods were tested: 1) the poly approach where a sealed internal polyethylene sheet and caulking provide the air barrier; 2) an external air barrier approach (EASE), using a continuous vapour permeable membrane, sandwiched between two layers of external wall sheathing; 3) and the airtight dry wall approach (ADA), where the interior gypsum board finish, together with framing materials and gaskets, are the air barrier.

When considering how any air barrier system may work you have to keep in mind that the wall can remain open, unfinished for sometime. During this period, some components may be unprotected, vulnerable to damage from high wind loads and mechanical damage be that may not get fixed up before being covered up.

The POLY Approach relies on the polyethylene vapour retarder and acoustical sealant to form the airtight envelope. Polyethylene is essentially airtight and has a low water vapour permeability, but it is subject to break-down when exposed to ultra violet radiation, and requires overlapping joints with mechanical clamping between rigid members for durable sealing.

The EASE approach eliminates many of the problems caused by penetrations through the interior gypsum board such as framing, electrical outlets, and light switches, by placing the air barrier on the outside. From a building science perspective, putting the air barrier on the outside or cold face of the building could allow convection currents to move indoor air to the cold face of the insulated wall if there is any air leakage from the interior into the wall, and the insulation is not installed evenly, without air channels in the wall. The interior surface still has to be reasonably well sealed in order to avoid excessive condensation.

However, the double layer of fibreboard is not a standard building practice and could create problems around windows and doors, etc.

The ADA approach relies on rigid interior cladding materials, such as gypsum board, and gaskets to resist air flow. While not effective as a vapour retarder, gypsum board is very resistant air flow. Being a rigid material, it is also not likely to be damaged by high air pressure differences.Care is usually given to its installation as it is the finished surface and any holes will be quickly covered up with dry-wall joint compound by occupants. The water vapour resistance required can be provided by using foil backed drywall, polyethylene or vapour resistant paints.

Techniques that are good for achieving a good air seal can be applied to more than one air sealing system.

The Study

Twelve sample panels using each of the three details were built using each of these construction approaches. They were put in a test chamber so that air pressures could create infiltration or exfiltration through the panel, under loads similar to those due to wind action: from 50 Pa to 1000 Pascals (1000 Pascal pressures are often encountered in high rise construction, but low rise buildings can easily encounter pressures of several hundred pascals). Measurements were made at several stages in the construction of each sample to see the effect of different components on the air leakage.

All test panels were 2"x 4" framing with ½" gypsum board interior. Exterior sheathing was Fibreboard for the POLY and ADA approaches, ½" chipboard for the conventional approach, and a layer of Tyvek sandwiched between 2 - ½" fibreboard sheets in the "EASE" approach.

A traditional wood-frame wall construction detail with no special attention to achieving a continuous air barrier, was tested also, for comparison.

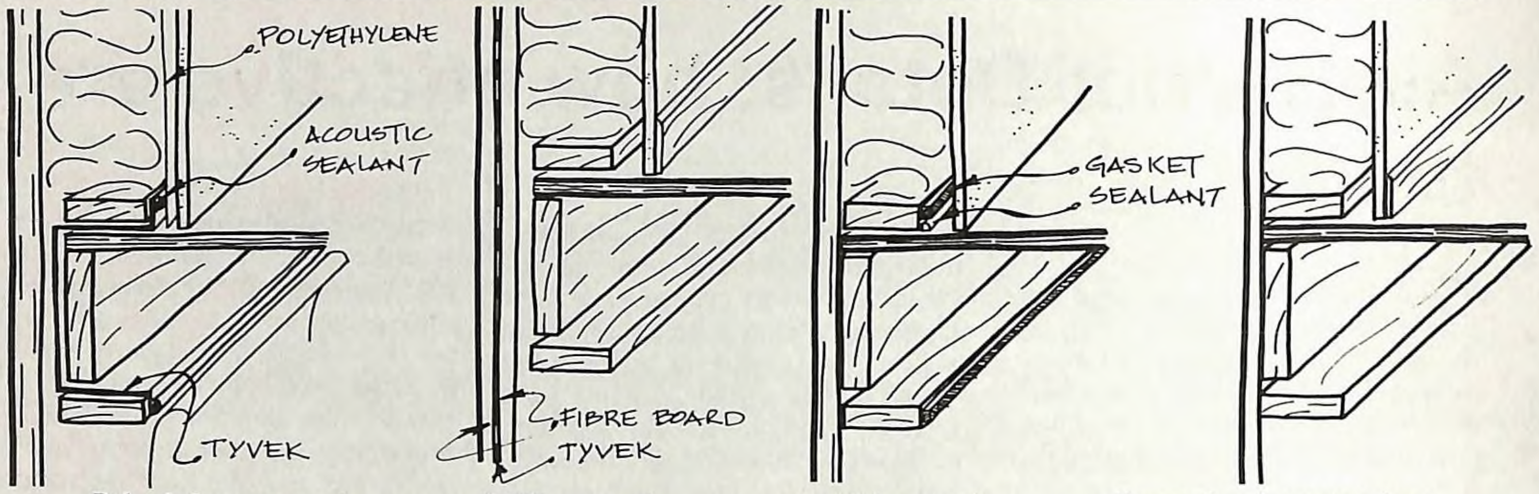
Joist header detail

The POLY sample had a layer of Tyvek wrapped around the exterior face of the header, sealed to the continuous polyethylene air/vapour barrier on the inside with acoustic sealant.

The EASE sample had no special treatment.

The ADA panel used ethafoam gaskets between all joints in a vertical plane, from the edges of the gypsum board to the foundation sill plate.

At a pressure difference of 75 Pa the leakage rates for the POLY, EASE, and ADA panels were about 24%, 18% and 10% respectively of that for the traditional approach. The POLY sample, sealed with an acoustic sealant, when tested before installation of the interior wall board, failed at 50 Pa in the infiltration mode. Most of the air flow resistance of the traditional panel was provided by the chipboard sheathing. There is still some concern about permanent damage



Polyethylene approach *EASE approach* *ADA aproach* *Conventional construction*
Joist Header details

to acoustic sealant joints in the POLY approach when subjected to moderate-to-high wind speeds during construction, before the interior wall board is installed.

Window detail

The POLY sample had plywood strips sealed to the outside surface of the window frame prior to installation in the rough frame opening, the poly sealed to the plywood with acoustic sealant. (Obviously this details only appleis to wood frame windows).

In the EASE sample Tyvek was wrapped around the rough frame of the window opening, the shim space filled with one-part urethane foam.

In the ADA panel, a strip of duct tape between the window frame and gypsum board was used to bridge the shim space.

The leakage rates were lowest for the ADA and similar for the POLY and EASE samples, all less than 15% of that for traditional construction.

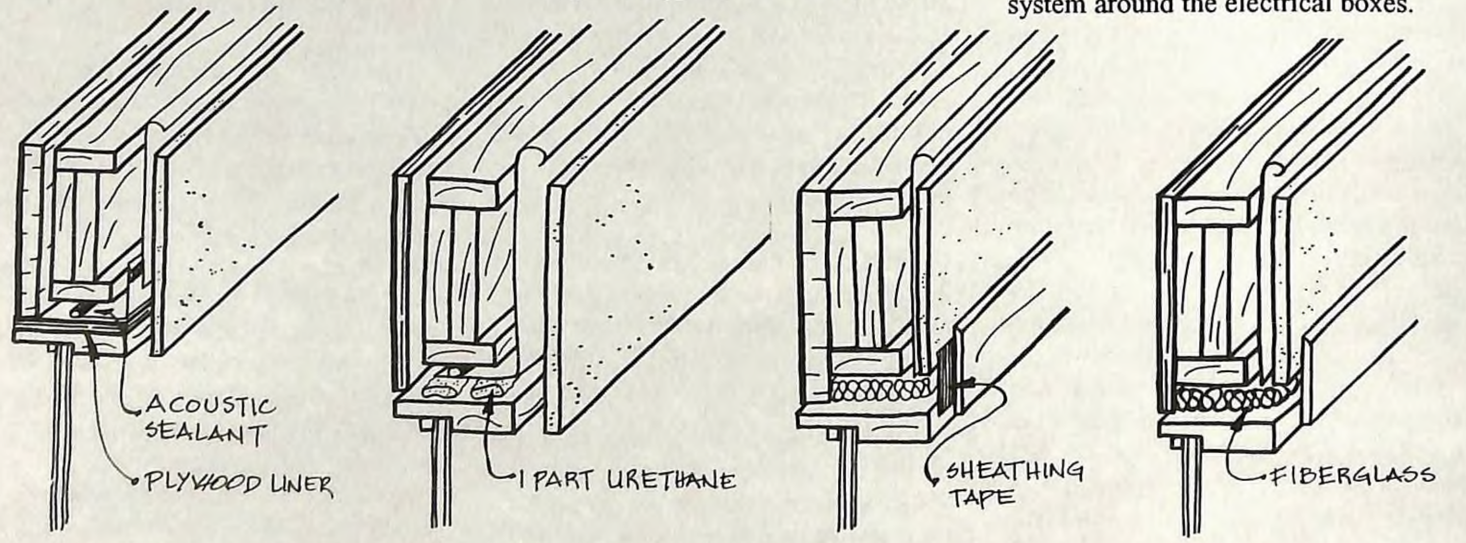
When tested before installation of the interior wall board, the POLY panel failed at the joint of the polyethylene and plywood around the window frame at a pressure difference of 100 Pascals.

Electrical outlet detail

The POLY sample used pre-formed polyethylene pans fitted through a plywood panel support let into the studs, the flanged surfaces of the pans were sealed to the polyethylene air barrier with acoustic sealant.

The EASE panel received no special treatment, while in the ADA panel, the gypsum board was simply cut around the box and a closed cell face gasket was placed between the drywall and the electrical outlet cover plate. No special steps were taken to seal the electrical box detail in the traditional panel.

The leakage rates for the POLY and EASE panels were about 24% and 36% of that for the traditional panel at 75 Pa pressure difference. The ADA panel had a higher leakage rate than the traditional panel, because of the gap in the air barrier system around the electrical boxes.



Polyethylene approach *EASE approach* *ADA aproach* *Conventional construction*
Window details

Electrical base plate gaskets are a poor way of sealing electrical boxes when compared to a sealed box system like the poly pan or using the new airtight boxes now on the market. (It is important to note that the new airtight electrical boxes now available were not used in the test).

Overall, all but the traditional samples and the ADA electrical outlet panel exceeded the current tightness standards for glass and aluminum curtain walls, but only the ADA window panel met a suggested goal proposed by NRC researchers. All three approaches could meet the airtightness standards of the R-2000 program.

The total air leakage calculated for each of the sealing approaches is less than 20% of that in traditional construction where no efforts at air sealing were made.

Of the details tested, window detailing offers the greatest potential for increasing overall airtightness compared to traditional construction methods. The poly approach appears to be most susceptible to damage under high pressure.

How tight should buildings be? There are no standards to define how much air leakage is acceptable but the R-2000 has a standard that is tested at a 50 Pascal pressure difference.

Table A provides the leakage values for each sample assuming all the air flow moves through the detail. This gives a rough estimate of how much each detail contributes to the overall leakage of a house, and why we need to focus on some details more than others. The numbers may seem small, but when you add up how many feet of each type of joint there is in a house, you get a sense of how much leakage there could be.

Test panels were built in the lab so they would be better built and have lower leakage values than a similar detail would have in a house. The potential for problems due to a leak in a confined area such as a joint detail may be much greater than its proportion of total leakage.

CMHC Research Project: Testing of Air Barrier Construction Details. Study conducted by Morrison Hershfield Ltd. 1991

TABLE A

	Joist Header (cfm/10 ft. detail)	Electrical Box (cfm/electric box)	Window detail (cfm/10 ft. detail)
POLY approach	.322	.0129	.452
EASE approach	.252	.0194	.400
ADA approach	.142	.245	.052
Conventional construction	1.42	.0549	3.874

Airtightness: how does it measure up over time?

Airtightness describes the ability of the building envelope to resist air infiltration which is created whenever a pressure difference exists across the building envelope.

A Pressure differential can be produced by natural forces (i.e. wind or stack effect) or by the houses's mechanical systems (i.e. heating or ventilation systems or any other appliances which move air in or out).

The ideal building envelope will not allow any unintentional air leakage to occur as this can increase energy costs, degrade air quality and comfort, produce moisture-related envelope problems and increase the transmission of outdoor noise to the interior.

In practical terms, air leakage can't be eliminated, but it can be controlled. The National Building Code requires airtight construction, but doesn't have any quantitative requirements for airtightness. The first Canadian standard for airtightness in residential construction was established by the R-2000 Program, which set limits on maximum air leakage allowed and also specified testing methods.

A three year study of 24 houses in Winnipeg was done to see how different air barrier systems work overtime. The houses studied were built between 1985 and 1989 by Flair Homes Ltd., a large tract builder. Airtightness tests to measure changes in air leakage were done regularly over monitoring periods which ranged up to 36 months .

The houses were all conventional bungalows with full basements and net main floor areas of 646 sq.ft.to 915 sq.ft. and used the polyethylene air barrier system or the Airtight Drywall Approach (ADA). With one exception all were sold and occupied shortly after completion.

The initial airtightness tests were done shortly after being finished, but before occupancy. In half the cases, tests were also performed before the stucco was put on. (This is noted because stucco can improve the airtightness significantly).

The ten houses which used the polyethylene air barrier system were built with four commonly used systems: standard frame walls; frame wall with exterior insulated sheathing; frame wall with interior strapping; double wall.

Stucco had little effect on the airtightness of the double wall houses but did produce significant reductions in airtightness for the two houses which used either standard frame walls or frame walls with interior strapping. This suggests that the latter two air barrier/wall system combinations had leakage sites which the stucco sealed at least partially, but the same leakage areas were not in noted in the double wall houses.

The Airtight Drywall Approach was used in 14 of the houses. Development of the ADA system has continued since the project houses were built, so improved gaskets and construction methods are used today.

Both air barrier systems are used to meet the R-2000 airtightness standard. The tightest envelopes were those constructed with the double wall technique and polyethylene air barrier systems.

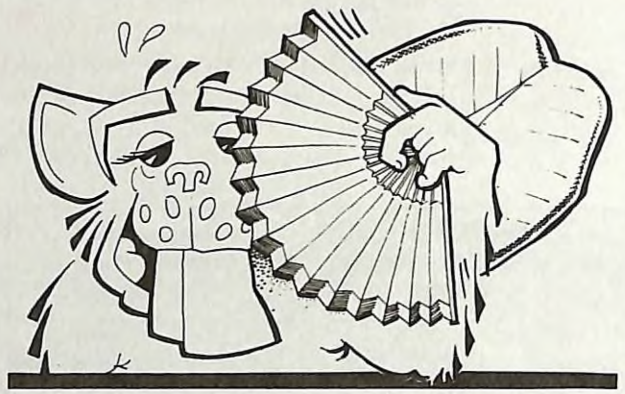
Two of the ten stucco-covered houses, using the polyethylene air barrier showed a small amount of airtightness degradation over the monitoring period. However, the changes in airtightness were small and not judged to be significant.

Six of the 14 houses built with an early version of the ADA air barrier system had a slight degradation of airtightness, but the magnitude of the changes was small and not judged to be significant.

Stucco produced significant reductions in airtightness for most of the polyethylene and ADA air barrier system houses.

Measured Airtightness of Twenty-Four Detached Houses Over Periods of up to Three Years Prepared for: Efficiency and Alterative Energy Technology Branch (CANMET), Energy Mines & Resources Canada by: UNIES Ltd., Winnipeg MB

Mechanical Ventilation: how do people really use it?



Mechanical ventilation systems must not only have the proper physical capabilities but, they must also be used regularly if they are to do work as intended. Up to now most studies of residential ventilation systems have focused on developing or evaluating the system capabilities: establishing standards for the ventilation system and its components - easy to regulate and inspect but that's about it. Little consideration has been given to how systems are actually used.

A mechanical ventilation system must meet two requirements to be an effective tool for improving indoor air quality. First, it must have the appropriate capabilities such as air flow capacity, distribution and to minimize adverse interactions with other systems, appliances or the house envelope. The second criteria is, simply, that it must be used regularly. The most expertly designed, carefully installed ventilation system is useless if it is not used by the homeowners.

A multi-year study (Part of the Flair Homes Energy Demo/Canadian Home Builders Association Flair Mark XIV Project in Winnipeg.) monitored the use of 12 conventional Heat Recovery Ventilators (HRVs), two exhaust-only HRVs and three central exhaust systems. The systems were installed in R-2000 and conventional houses, all built with airtight building envelopes. Monitoring periods were from 9 to 40 months.

All were detached bungalows with similar floor plans, full basements and net main floor areas of 646 sq.ft. to 915 sq.ft.

Purchasers of the houses were informed that their homes were to be monitored in the multi-year study. They received verbal and written descriptions on the ventilation systems, their purpose, operation and maintenance requirements. Further assistance was provided by a technical during monthly site visits and whenever repairs were carried out.

The three central exhaust systems were designed for use with single-speed blowers located in the basement and controlled by dehumidistat and/or manual switches on the main floor. The homeowners generally activated the systems using the manual switches or used the dehumidistat as a switch. Only once the ventilation system was found to be operating under the control of the dehmidistat.

Central Exhaust Ventilation Systems

Homeowner use of the three central exhaust systems averaged only 37 minutes per day, producing an average seasonal mechanical ventilation rate of 0.01 ac/hr. while the installed flow capacities ranged from 0.45 ac/hr to 0.72 ac/hr. This was less than 3% of the ventilation rate if the systems had been operated continuously at the minimum ventilation capacity specified.

The three houses with central exhaust also contained 4" make-up air ducts connected directly from the outdoors to the return air plenum (which induced a flow whenever the blower was operating). Measurements of make-up air duct flow rates showed a wide variation. In one house the rate was comparatively large, at 76 cfm, but in another it was only 3 l/s (6 cfm). The difference was created by the respective ducting arrangements; in the other first house the make-up air duct entered the plenum close to the furnace while it was almost at end of the plenum, at a considerable distance from the furnace where the static pressure was minimal.

Heat Recovery Ventilators

HRV systems are designed for continuous low speed operation, with high speed operation prompted by dehumidistat activation or by manual override switches in the bathrooms and kitchens. The units could only be turned off by unplugging them, an intentionally inconvenient method.

The 12 conventional HRVs were operated an average of 19.3 hours per day, giving an average seasonal mechanical ventilation rate of 0.33 ac/hr, although large variations were found between the houses and in different seasons. Most of the total air change rate was provided by mechanical ventilation, not natural infiltration. Houses with forced air heating lower mechanical ventilation rates than those with electric baseboard heating. Natural infiltration rates, although of roughly the same magnitude as those experienced by the three houses with central exhaust systems, were small compared to the mechanical ventilation rates.

The type of control systems may have also affected how homeowners used their systems. Two of the three central exhaust systems used automatic controls and single speed blower operation. Observations from the site visits suggest that the homeowners treated the dehumidistat as on/off switches. Psychologically, they may have regarded the central exhaust systems as an optional feature to be activated when there was a perceived need for ventilation, as opposed to a system designed to operate automatically. The large flow capacity of the central exhaust systems may have also increased perceptions of energy waste. By comparison, the HRVs may have been viewed as more complicated devices, whose operation, although not totally understood, required near-continuous use. The heat recovery capability of the HRVs may have also reduced perceptions of energy waste. Many comments were received from the homeowners that they did not understand the use or operation, of their HRVs, even after two or three years of occupancy and in spite of the written instructions and verbal explanations.

The homeowners were probably more typical of the general public than those in other research projects. Individuals who purchased the houses in the Flair project received incentives to do so in the form of free energy conservation options, so many of them could not be classified as conservation enthusiasts with a special interest in the house and its unique energy related features.

Documents such as the National Building Code and CSA F326, are written to house the general public, not just energy enthusiasts. The results of this study may be indicative of actual usage patterns for merchant-built houses constructed to these codes and standards.

The study concluded that additional thought must be given to homeowner education and to the operation and control of ventilation systems, the homeowner interface.

Utilization of Residential Mechanical Ventilation Systems prepared for: Efficiency and Alterative Energy Technology Branch (CANMET), Energy Mines & Resources Canada by G. Proskiw, P. Eng. Unies Ltd. Winnipeg MB

Ventilation fan noise

by Dave Quirt

Nothing discourages people from using fans in bathrooms or kitchens more than their noise. Several surveys, including one by CMHC, showed many people don't use the fans in their homes because of the annoying noise.

Interestingly, the least expensive fans are not the noisiest; nor do noisier fans provide better air flow, so it's unclear why builders choose particular fans.

Nevertheless, fans are essential to prevent moisture problems and enhance air quality.

The National Building Code recognises the need for ventilation and requires that mechanical ventilation be installed in residences, and a new Canadian Standards Association (CSA) standard for laboratory testing of residential fans has been recently issued. Among other things, this standard covers sound emission ratings and is intended to help builders select quieter fans.

To evaluate the accuracy of the CSA standard (CAN/CSA-C260), the Institute for Research in Construction (IRC) carried out a two-part study to evaluate the laboratory test procedures and establish the relationship between the laboratory rating and actual field performance. Results indicated that the standard, is in fact, valid.

In the first phase of the study, 11 fans were tested in the IRC acoustics laboratory to rate sound power emission. For the tests the fans were mounted on a test stand with wood frame and plywood surfaces. This simulated the effect of vibration

transfer from an installed fan to any supporting structure. A duct between the test stand and an adjacent space handled airflow that would be ducted to or from outdoors in normal installation. Additional cupboards were added to closely match a typical kitchen installation for the range hood fans.

The second phase involved testing the same fans in the field. For these tests, fans were installed in the kitchen and bathrooms of a series of new two-storey, semi-detached houses; each had its main bathroom on the upper floor and a kitchen and smaller bathroom on the lower floor.

Because the homes were not occupied, none of the floors were carpeted and the rooms were bare, so sound reverberated noticeably. However, for sound pressure measurements, absorptive panels were placed in the rooms to bring acoustic absorption into the range expected with normal furnishings. All doors were closed during sound tests.

Sound power ratings (much like light bulb power in watts) relate to the property of the noise source. Sound pressure accounts for the intensity of the noise when the source is installed in a room; it depends not just on the source but also on the listener's location and on the characteristics of the room. For instance, the larger the room and the more absorptive its surfaces and furnishings, the lower the resulting sound pressure level. It is the sound pressure level that determines annoyance.

The IRC study showed that sound pressure measurements in the field and the laboratory can be predicted quite well from the CSA standard laboratory tests. The range hoods gave slightly higher sound power levels in the field measurements, but the bathroom exhaust fans had lower sound power in the field.

The average deviation between measurements taken in the lab and those taken in the field were only 1.4 dB, too small to be noted by the human ear and well within measurement accuracy. (People can't detect changes in sound of less than 3 dB.

The IRC study confirmed the reliability of the CSA standard as a satisfactory technical approach for predicting noise from residential ventilation. The next step might be to establish acceptable values of fan noise and to use the standard to rate fan units. For now, builders can use the ratings according to the CSA standard to compare fans when buying them.

The ultimate goal is to encourage people to use the ventilation equipment in their house. Installing quieter fans ought to improve the chances of having them used.

Dave Quirt is a researcher with the Institute for Research in Construction

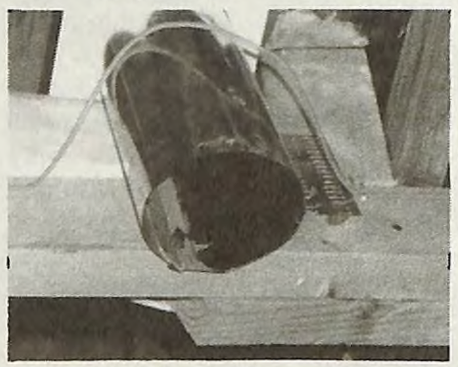
New Product: Speedi™ Sleeve

We don't build houses the way they used to - today we do it much better.

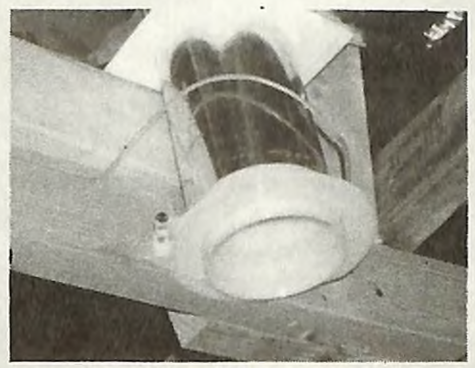
Customers demand much higher quality than ever before, and it is interesting to see that a new sophistication developing in the building trades, subtrades, and suppliers to meet that demand.

The days the tin basher could slap some sheet metal into a house and call it a heating or ventilation system are quickly disappearing. To make life easier for the sheet metal trades, as well as the builder, manufacturers are developing new products.

A new product just unveiled is the **Speedi™ Sleeve**, a ceiling termination fitting for 4" ducts. With increasing use of 4" diameter ducts located in the ceiling (for ceiling supply or exhaust grilles) the question is, how do you finish it? And what about the poor drywaller expected to cut a neat circle, small enough to enable the sealing of the drywall to the duct? Inevitably they're a mess that is difficult to seal.



Standard 4" duct termination



Speedi™ Sleeve

The folks at Eneready Products, the developers of the Albo® (the 90° elbow fitting for 4" ducts) have followed up on a suggestion of Steve Traaseth of Parkinson's Heating in Surrey B.C. to design the **Speedi™ Sleeve**, a ceiling termination fitting for 4" ducts. The fitting makes it easy to finish drywall, maintain the seal, and air seal the drywall.

The **Speedi™ Sleeve** is made of recycled polyethylene that makes it flexible enough to be able to slide into a duct (even if it's been slightly deformed). It has a flange that can have a gasket for use where it's needed to maintain a seal in ADA construction, and nailing sleeves for perfect alignment of the 2 nails (or screws) that hold the sleeve against the framing (it's not unlike the airtight electrical boxes now available).

For information:
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1992 International Energy Efficiency and DSM Conference October 20 to 22, 1992, Toronto ON. Sponsors: Canadian and European Utilities, International Energy Agency, International Institute for Energy Conservation and the US. Department of Energy. 100+ speakers from 22 countries; conference will cover a wide range of DSM issues such as program design and implementations as well as energy efficient technologies, rates and pricing.
For information: Marybeth Paul (215) 667-2160

Thermal Performance of the Exterior Envelopes of Buildings . . . Building Thermal Envelopes V Dec. 7-10, 1992 Clearwater Florida. Information Tel: (615) 574-4345, Fax (615) 574-9338.

Building Solutions Conference: Uniting Excellence & Innovation, 1993 Energy Efficient Building Assoc. conference, March 3-6, 1993, Boston MA. For information: William Lemke, EEBA Headquarters, 1000 Campus Dr. Wausau, WI 54401 Tel: (715) 675-6333 I, Fax (715) 675-9776

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en francais	
Gatineau Nov. 19	Montréal Nov. 25, 26
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Information: Arthur Bennett, Client Services, Institute for Research in Construction, National Research Council Canada, Ottawa, Ont. K1A 0R6
Tel 613-993-0435 FAX 613-954-5984

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BACK ISSUES SPECIAL
We still have some back issues of SOLPLAN REVIEW. Individual copies of back issues are available for $4.00 each, post paid.

PACKAGE DEAL: We have a special deal on back issues if you are missing a number of them: we'll send a package containing all available issues from No. 4 to 36 (there are a number out of print), but in any case there will be at least 20 issues for only $ 40.00 (plus GST); USA and other foreign $50.00.

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PC-Solar™ 1.1

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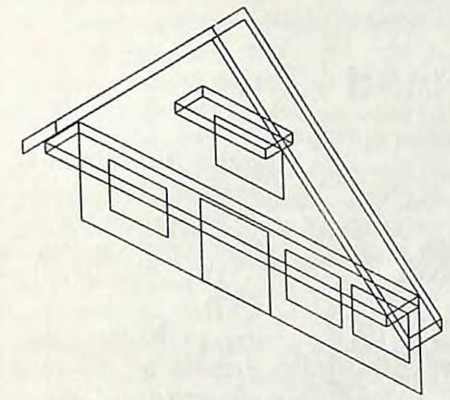
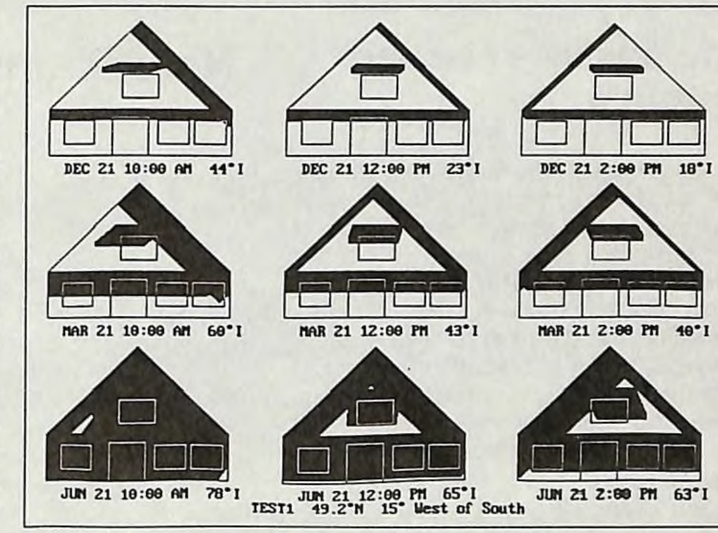


Every so often you run across something that doesn't seem like a big deal - but when you take a second look it turns out to be a little gem.

That's the case with a small software program called PC-Solar. It is a graphics program that simulates shadings of overhangs to help design shading devices for solar heat gain and shade cooling. If you have the luxury of being able to rotate the building, you can do it in 1° increments. Latitudes are available in 0.1° increments from 23.6° N to 66.5° N. (For USA users, there is a U.S. database that accesses a location by it's ZIP code).

The calculations don't need a computer. In 1978 we published *SOLPLAN 2, Solar Energy for Existing Homes,* which included sun path charts to manually plot the sun's path and calculate areas in shade. The difference with PC-Solar is that it uses the full power of the computer to quickly and visually show you the impact of shading devices. There is even an animation feature to show shadow movements across a wall throughout a day for different days of the year - you actually get to see shadows sweeping across the wall.



Other features include display of solar collector incidence charts to help orient collectors, skylights, greenhouse glazing, etc. It doesn't do energy calculations, but it helps the designer to visualize shadow patterns quickly. It allows the designer to play the "what if" game with solar geometry.

The beauty of the program is that is very easy to use. It loads itself, and you can start using it immediately. Within half an hour you can have a print out. Even if you are a new computer user, you shouldn't have too many problems. The User Manual that accompanies the program is basic, but has enough infomation to help you if you run into trouble.

Equipment Requirements: PC compatible computer (DOS 3.0 or higher), colour VGA monitor, hard disk, high density floppy drive, and at least 640 K of memory. Printing requires a Hewlett-Packard or compatible laser printer or Epson or compatible dot matrix printer.
US$ 55. (US$45. in the USA).
Information: 3-D Software,
P.O. Box 1373, Poway CA 92074 USA.

R-12 Windows?

We've seen many changes take place in the glazing industry in the past few years, so much so that new glazings are much better than the frames we put them into, and almost as good as the walls themselves!

Windows with a centre of glass value of R 8 are now marketed by a number of North American manufacturers. However, when you factor in the effect of the frame, window edge (including spacers), the composite value of these is about R 4, much less than 8 but still much better than conventional double glazing (that are less than 2).

Hard as it may seem, a window with a centre of glass R-12 value (composite R value 5.3) can be manufactured, and in fact will be on display at the Manitoba Advanced Home Project.

The window was developed by Willmar Windows of Winnipeg. It has 4 glazing layers: double Heat Mirror films plus a low-e coated glass pane, with insulating spacers and Krypton gas fill in a metal clad wood frame. Surprisingly, it still has a high visible light transmission.

This is a prototype unit developed by Willmar Windows as a response to the call for new technology innovations put out by the Advanced Houses Program. The manufacturer does not have plans for marketing the product at this time, but will monitor the response, and if there is sufficient interest, they may.
For information: Willmar Windows,
Winnipeg, Manitoba
Tel: (204) 668-8230

EMR/CANMET NEWS

The Canada Centre for Mineral and Energy Technology (CANMET) is the research and development arm of Energy, Mines and Resources. EMR/CANMET's Buildings Group works with industry to develop and commercialize the technologies to make Canadian houses more energy efficient. With the support of the Buildings Group, Solplan Review presents this information on some current CANMET projects. For more information contact: Energy Efficiency Division, EMR/ CANMET, 580 Booth St., Ottawa, K1A 0E4.

The Advanced Houses Program

We continue our update on the Advanced Houses Program with a look at three more winning submissions. Each of the Advanced Houses had to meet the same set of technical requirements (see box). The requirements demanded that the teams find and/or develop innovative materials and mechanical equipment to solve problems and inefficiencies associated with conventionally constructed houses. Each of the teams arrived at their own unique solutions. Reviewing all the designs, however, reveals certain trends, particularly in envelope construction, window choices, and the integration of mechanical systems -- trends that will undoubtedly become building standards in the not-to-distant future.

Energy Requirements

Total purchased energy is 50% less than R-2000. It is the sum of the individual performance targets in the following categories, with trade-offs allowed: space heating; space cooling; domestic water heating; appliances; lighting; and outdoor electricity.

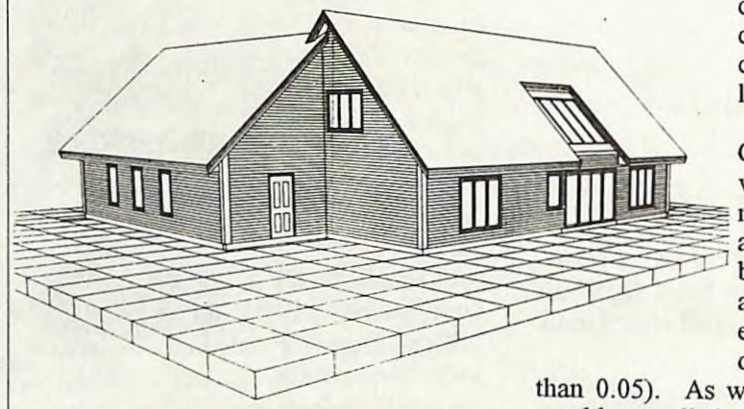
Environmental Requirements

A 50% water reduction target, use of Ecologo products; recycling facilities; use of recycled materials; no CFC's; emission limits for wood burning equipment; and a construction waste management plan.

Indoor Environment Requirements

Room-by-room ventilation; indoor air quality guidelines; noise limits; and humidity control.

New Brunswick Advanced House



The New Brunswick Advanced House is a two-storey, 1,800 square foot home located in Fredericton. The design team viewed the house as a "laboratory -- a place to try things that had never been tried before". As a result, the house features a number of prototype systems in heating and cooling, controls and envelope materials.

Heating and Cooling Technology

The house features two prototype heating and cooling systems: a direct exchange ground source heat pump (GSHP), and an integrated air-to-air heat pump and HRV. Both systems are capable of meeting the design heating and cooling loads. Installing two systems, however, gives the team a chance to compare their respective cost, performance and benefits.

Direct Exchange Ground Source Heat Pump

During winter, the anti-freeze based ground loop of a conventional GSHP picks up heat from the soil and transfers it to a CFC based refrigerant. Either a fan coil or water heat exchanger is used to recover the heat and deliver it to the house.

The prototype GSHP in this Advanced House eliminates the anti-freeze to allow a direct exchange between the ground and a non-CFC refrigerant (with an ozone depletion factor less than 0.05). As well, the pump which would normally be used to move the anti-freeze through the ground loop is eliminated and this function is performed by the heat pump compressor. The estimate is a 15% to 20% improvement in Coefficient Of Performance (COP) by eliminating one heat exchange and one pump.

Heating systems are typically sized for worst case conditions, so they typically operate at peak efficiency for only a short period each year. During the rest of the heating season, the efficiency is lower as shorter cycles limit the ability of the system to reach steady state. In this prototype GSHP, the compressor will have variable speed capabilities, allowing the heat pump to adjust its capacity to match house heat loss. Because the capacity can vary to match the house heating (or cooling) demand, the system will be able to achieve a seasonal COP much closer to the design COP. The seasonal COP for the system is estimated at 4.0 or better.

Air-to-Air Heat Pump with HRV

Regular air-to-air heat pumps and HRV's are installed separately. In this house they will be integrated into one unit, to apply exhaust air heat recovered by the HRV to improve heat pump efficiency. In general, with air-to-air units the COP decreases as the outdoor temperature drops because it is more difficult to extract heat from the cooler air. Using captured heat from the exhaust stream to warm the incoming air stream that feeds the heat pump should significantly improve the seasonal COP of the unit - and make the unit less reliant on outdoor air temperatures. Air-to-air heat pumps typically operate at a seasonal COP of 1.4 and provide a 20% energy saving over conventional heating systems. The design team estimates that the integrated system will raise the heat pump seasonal COP to 1.8 and provide energy savings in the order of 40%.

This system will also feature a variable speed compressor for efficiency improvements from optimal cycling. In addition, as a comfort measure, fan speed is matched to the compressor so that when supply air is delivered at cooler temperatures it is delivered at a slower rate.

Peak Load Electrical Management System

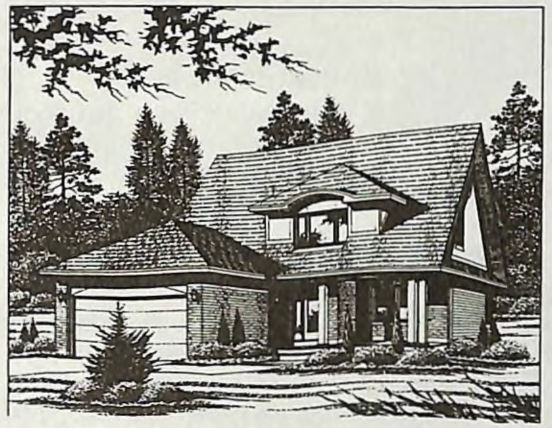
The design team has developed their own monitoring and control software program called ADQUIRE, that will soon be commercially available. ADQUIRE gathers and correlates data on all mechanical equipment in the house, including appliances. It will monitor performance of all systems and control electrical load for peak management purposes.

Exterior Roof and Wall Cladding

To maximize efficient use of resources, the New Brunswick Advanced House will use a new product made from waste wood fibre for roof sheathing and exterior siding. Typically, composite wood products are manufactured using highly toxic binders. The new product from Canexel, a division of Canadian Forest Products Ltd., is produced by compressing the wood fibres under high heat and pressure. The binders are non-toxic and the product is 100% biodegradable.

In keeping with the 'natural' approach, non-toxic stains will be used for all exterior trim and non-toxic paints will be used for interior finishes.

Innova House



The Innova House is a two-storey, 2,000 sq.ft. home in the Ottawa area. This team's goal was to be innovative, while at the same time using and developing techniques and technologies most likely to be adopted by the main-stream building community -- especially large tract builders.

Wall System

The exterior walls will be single-stud (2 x 6), with a prototype exterior insulation board, for a combined RSI of 6.3 (R 35). The frame wall will be filled with a blown-in-place cellulose batt (100% recycled content). The exterior insulation is a rigid phenolic board developed by Fiberglas Canada. This will be the first use of the product in a wall application. It has a high R-value - approximately 8.5 per inch, made using a non-CFC blowing agent.

The project will evaluate how well the board withstands damage during handling and how easy it is to install.

Heating, Cooling and Ventilation System

The mechanical system demonstrates an integrated heating, cooling and ventilation system using state-of-the-art, off-the-shelf and prototype components to provide greater energy efficiency. The central blower for the air handling system uses a prototype ECM (electronically commutated motor) from GE with a 75% efficiency rating. Two DC motors on the HRV provide a 40% reduction in energy use over conventional motors. HRV fans will supply air directly to the rooms without the use of a recirculating central air distribution system, further reducing electrical consumption. The HRV is a rotary wheel heat exchanger, which transfers both heat and moisture between the fresh air supply and exhaust air streams. Cooling of the house using outside air will be possible using a Honeywell Total Home Automation package which will sense when free cooling is available and control dampers accordingly.

The system is expected to save 2694 kWh per year of fan energy and some 250 kWh of air conditioning.

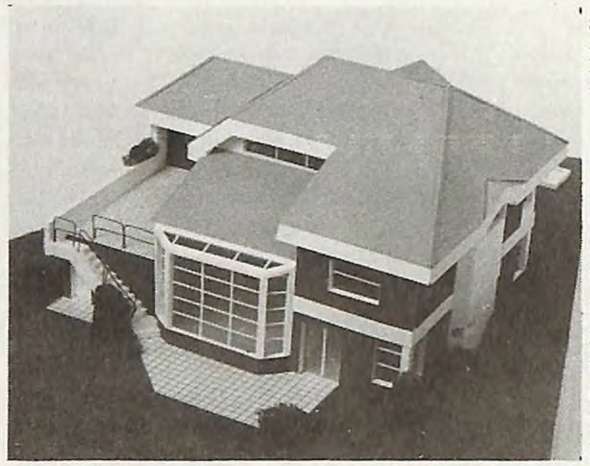
Supply Air Ductwork

The house features an innovative supply air system that consists of an extended plenum running under the first floor with small diameter (50 mm/2") flexible ducts running to all supply points along interior walls. The highly insulated building envelope results in warmer, more comfortable exterior walls and makes it possible to deliver supply air to the interior walls. The small design heat load means that air flow rates can be lower, allowing smaller ducts to be used. The short duct lengths will reduce friction losses and improve system efficiency, be easier to install, especially with the shortness of the duct runs, and with the ability of the flexible ducts to bend at corners so that no joints are required.

PV Installation

A Photo Voltaic (solar electric) system with a two-way interface connection is to be installed. (An arrangement to feed excess electricity back into the grid is still under discussion.) The PV system will supply most of the electrical needs. Combined with the high-efficiency gas water heater, prototype sealed combustion gas range and high-efficiency gas clothes dryer, the Innova House will be almost entirely independent of the grid.

Maison Novtec



This project involves the construction of two houses - one built to 1990 Building Code specifications and the other to Advanced House Technical Requirements. The houses will be built next to each other in Laval, a suburb of Montreal, to allow a direct comparison of the cost and benefits of the innovative features.

Commercial Construction Techniques

The house features a number of commercial construction techniques, including the use of exterior "Outsulation" sandwich walls, moveable interior walls, and a protected membrane roof section.

Outsulation Sandwich Walls

Conventional wood frame wall systems are labour intensive, requiring separate passes for framing, exterior sheathing, exterior insulation (if used), and siding. Additional passes are made on the interior for insulation, air barrier and interior finish. This project will demonstrate the use of a 'sandwich' wall cladding applied to the exterior of a wood frame wall. It will provide a continuous air barrier, exterior insulation, sheathing and siding, all in one step. The 'sandwich' is made of 12mm (½") plywood, 38mm (1 ½") extruded polystyrene insulation, 12mm (½") plywood, 19mm (¾") polystyrene insulation and 38mm (1 ½") brick. Services will be run on the inside and the stud cavities filled with batt insulation. The total wall system is RSI 6 (R 34).

Moveable Walls

Walls, floors (which span from exterior wall to exterior wall) and ceiling are finished before the steel track-and-stud framing of the interior partitions is put into place. The moveable walls allow changes to the living space to meet changing occupant requirements without affecting structural elements of the building. They are easy to build and should provide better sound and fire resistance than wood frame walls.

Protected Membrane Roof Section

Commercial buildings have successfully used technologies for insulating and waterproofing flat roofs. Applying this to a house allows for the creation of quality outdoor space without increasing the house footprint. In the Maison Novtec, a roof terrace is created over the garage, using a protected membrane roofing system. The flat roof, over the insulated joists above the garage, is a plywood base; a 2-ply water-proof membrane made largely from recycled plastic; a 100 mm (4") thick T & G rigid foam insulation, and a water permeable 'rubber crumb' membrane made largely from recycled rubber. The insulation and the rubber membrane prevent wind uplift and floatation. The system is finished with cedar decking. The RSI value of the membrane and exterior insulation is 3.5 (R 19.8); and RSI 10.5 (R 60) for the total roof assembly, including insulated floor joists.

Ground Source Heat Pump

Maison Novtec uses standard equipment in a unique way to provide 100% of the heating and cooling load and all of the domestic hot water (DHW) load to a temperature of 120°F. The remaining DHW load is provided by an electric resistance heater.

The system consists of an exhaust air heat recovery unit combined with two ground source heat pumps connected in series on the same ground loop. The ground loop is the spiral loop developed by the National Research Council that has improved heat exchange capabilities, and reduces trench lengths by 40% over a 4 pipe layout or 70% over a two pipe arrangement.

The heat pump system is designed so that the ground loop first passes through a heat recovery unit to capture energy from exhaust air and solar gains from the sunspace. This raises the ground loop temperature to increase the COP of heat pumps. The loop then passes through a water to air unit sized to meet all the cooling load of the house and a portion of the heating load. The second heat pump, a water to water unit is sized to provides the balance of space heat through a grid of water pipes under the concrete floor slab and also provides hot water to the domestic hot water tank.

Using two separate compressors permits simpler refrigeration design and allows each heat pump unit to be sized more closely to the demand. Both units can run simultaneously on the same ground loop if necessary.

Richard Kerr, the mechanical designer, estimates that the water to air unit will achieve a seasonal COP (ratio of heating delivered to electrical energy used), of 3.2 for heating and cooling. The water to water unit is estimated to reach a seasonal COP of 3.0.

Planting Strategy

Maison Novtec has a detailed strategy for both indoor and outdoor planting, to improve air quality indoors and outdoors in the vicinity of the house as well as reduce energy consumption. Plants will be selected for their ability to metabolize pollutants, based on NASA research. Fungi growth will be avoided by using expanded clay as a potting material.

The exterior planting will demonstrate proper siting and landscaping criteria. This includes appropriate use of shade trees to reduce peak summer cooling loads, reduce CO_2 levels and to filter dust and airborne pollutants, as well as wind and noise barriers. Cooling load reductions of 25% have been estimated from appropriate use of shade trees. Computer modelling will be used to assess the benefits of different landscaping options.

Technical Research Committee News

Fire Sprinklers:

This is a warning to builders and associations to keep the dust off the material prepared last year by CHBA and CMHC on the sprinkler issue. It seems that the City of Thunder Bay is considering making residential sprinklers mandatory. Other municipalities are also talking about it.

As regular readers know, there has been lots of detailed analysis done to evaluate the merits of sprinklers in residences. While they are effective, making them mandatory imposes costs on new construction that is not justified.

Material identifying arguments for and against sprinklers, and information that will help builders make presentations on the subject are available from your local CHBA office or from the TRC national office. These include concise arguments, drafts for presentation talks, technical information, etc.

Energy Code:

We've reported in the past on the draft code for energy construction for residential buildings that is being prepared now. A fundamental, philosophical issue is whether there should be an energy code in the first place, or should the market place take care of the standards? This basic question can generate considerable discussion on its own.

At the same time, builders should think about the issue and be prepared to provide input. If you don't think it's important; that an energy code won't have a major impact, then think again. A rough draft of the code is being circulated for input. Some of the following proposals are in the draft. Are they going to have an impact on you? You be the judge.

Do you get full HVAC design drawings prepared for each house? (One proposal would require this).

Do you get an air test for *each* house you build? Is there enough air testing equipment to handle all construction in your area? This is what is being proposed.

You only use raised heel trusses? Good, because that is what is being proposed as a mandatory requirement.

You build shallow foundations? or on permafrost? Proposed wording would require foundations to be built to below frost penetration depth, even though insulated shallow foundations properly built are very efficient, affordable, and eminently practical, without paying any energy penalties if done properly.

HOT 2000 too difficult to handle? How about HOUSTRAD? This is the proposed program for trade-off calculations if you want to consider alternatives methods to meet requirements. What is HOUSTRAD program? We haven't seen it either, but apparently it is an actual program.

What about energy efficient lighting? Have you thought about occupancy sensors to control lighting? Will people tolerate this? This is a proposal being considered.

How well do you insulate fresh air ducts into the house? R2? How about R20? Ducts bringing exterior air inside, (e.g. combustion air to a furnace, or fresh air to the heat recovery ventilator) through a heated space have to be insulated, but it may be difficult or impractical to make it the same insulation value as the outside wall, which is what is being suggested.

You thought that an energy code, for energy conservation, would give credits for solar water heating? It's not written that way.

You want to build in Prince George or Sioux Lookout? You'll have to figure out what criteria apply. Rather than making requirements degree day dependent (a measure of the temperatures encountered), tables are related to specific city, leaving the way open for a lot of confusion in outlying areas.

Canadian Home Builders' Association

Concerned? Be sure that your local Technical committee is keeping in touch with the issue and is making presentations to the code advisory committee. If in doubt, contact the TRC directly.

Changes to R-2000 Technical Standards

For homes enroled after Sept. 1, 1992 the R-2000 Technical Requirements have been amended. The change affects combustion equipment. All wood burning fireplaces, woodstoves and pellet stoves must now be certified as meeting the requirements of either CSA B415.1-M92 (Performance Testing of Stoves, Inserts and Low to Medium Burn Rate Factory Built Fireplaces), or the USA EPA wood burning appliance standards (1990) CFR Part 60.

Gas and propane fireplaces permitted are direct vent or power vented units only. Effectively, site built masonry fireplaces are now not acceptable.

For specific details, contact your regional R-2000 manager.

The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector. Membership includes builders, representatives from industry, standards and governments bodies with an interest in housing. Anyone with a problem, technical question or suggestions for topics that need investigation is encouraged to contact their local Home Builder's Association technical committee or the TRC directly.

To contact the TRC:
Canadian Home Builders Association, 150 Laurier Ave. West Suite 200, Ottawa, Ont. K1P 5J4
Tel: (613) 230-3060
Fax: (613) 232-8214

IRAP Help

A service offered through the CHBA National Technical Research Committee is a program of the National Research Council of Canada called the Industrial Research Assistance Program also known as "IRAP". This service provides technical trouble shooting as well as financial assistance with research and development in the housing industry. Industry Technology Advisors specializing in construction are located across the country in different offices to better serve industry. These advisors are also linked by electronic mail so that they have wide access to different resources.

One of these advisors is located in the CHBA National office working with the CHBA Technical Research Committee.

IRAP has assisted in the drywall discolouration project and in the upcoming gas appliance testing. If you would like more information on the IRAP services or the local advisor in your area contact:

Ross Monsour Tel: (613) 230-3060 FAX: (613) 232-8214
or by mail: CHBA National Office Suite 200 - 150 Laurier St. West
Ottawa, Ontario K1P 5J4

R-2000 Technical Standards Review

R-2000 Technical standards are presently being reviewed by a team headed by Richard Kadulski. The mandate is to review and make recommendations on revisions that should be made to the standard in the light of the changes that have happened to construction practices and codes in the past 10 years, since the first standards were prepared. Lessons that are being learned in the Advanced houses program as well as new technologies will be considered for possible incorporation into the technical standards.

If anyone has any thoughts on what kind of changes should be made to improve the program, to make it easier to operate or to improve the product, you are welcome to contact Richard Kadulski directly (c/o SOLPLAN REVIEW) with your comments.

Environmental Building News

We'd like to think that SOLPLAN REVIEW has all the information that you need on energy efficient and resource efficient building practice. But we'll admit that there are a few good publications out there that cover similar material. (Then again, after more than 7 years in the business, we've seen many publications come and go.)

A new one has just been launched: the Environmental Building News is billing itself as a newsletter on environmentally sustainable design and construction, and will address issues such as low impact building material selection, site planning strategies for open space protection, how to evaluate construction systems in terms of their total environmental impact and alternatives to old-growth timber. Editor/Publisher is Alex Wilson. In all sincerity we wish the publishers good luck!

US $60 per year (6 issues).

For information: Environmental Building News, RR #1 Box 161, Brattleboro VT 05301 FAX (802) 257-7304

Products Catalogue

The Ontario New Home Warranty Program produces a series of technical publications and videos to illustrate correct construction methods and practices. The material may well be of help to others. The Catalogue lists available material and ordering information.

Ontario New Home Warranty Program 5160 Yonge St. 6th Floor,
North York, ON M2N 6L9 1-800-668-0124 (toll free Ontario only)

Guide to Resource Efficient Building Elements

You want to build using resource efficient materials; you don't want to contribute to the degradation of the environment if at all possible. So what do you do? Where can you find products that are not going to contribute to the destruction of the environment?

It's been a search done by trial and error. Now there is a guide that lists products and manufacturers of products. Published by the Centre for Resourceful Building Technology, the authors (Steve Loken, Walter Spurling and Carol Price) have many years of involvement with energy and resource efficient construction. This is the group that built the ReCRAFT 90 demonstration house in Missoula, Montana (SOLPLAN REVIEW No. 36, Dec-Jan 1991).

The nice feature about this book is that it lists products by categories, and includes a commentary about the products. Suppliers listed include USA and Canadian sources.

The Guide to Resource Efficient Building Elements US $ 20. from Centre for Resourceful Building Technology, Box 3866, Missoula, MT 59806

Energy Source Directory A guide to products used in energy efficient homes

Crisp, concise product descriptions, also identifies code and standards compliance. Spec sheet summaries of products indexed by brand name and manufacturer, organized by function, with photos or illustrations for most products. You purchase an annual subscription that includes three issues of the Energy Source Report newsletter that updates entries.

Products include air leakage control, heating, HVAC controls and ducts, ventilation equipment, insulation, moisture control, structural ventilation, testing and water conservation equipment, water heaters and windows and doors.

$175.00 (annual renewal $125.00)

Iris Communications Inc.
258 East 10th Ave., Suite E
Eugene, OR 97401

The following item was contributed by our accountant, who's just undergone the experience of building his own house. Had he relied on the services of a professional contractor, he should have avoided many of the pitfalls. However, my experience over the years has been that even the pro's get caught at it. Let's hope that none of our readers are guilty of any of these!

COMMANDMENTS ACCORDING TO A BUILDER

1. Nobody will notice after the drywall goes on.
(Translation - we goofed but if we slap enough drywall and plaster it will be covered up)
2. I will be on site tomorrow.
(Translation - I took on too many jobs but that can't interfere with my golf game)
3. It looked great on paper.
(Translation - I never thought that you would have to build this)
4. That was not included in the price.
(Translation - I bid low to get the job but I need enough money for the Vegas vacation)
5. Nobody (everybody) does it this way.
(Translation - I don't care what you want, this is the only way I know how to do it)
6. It's the plumber's (electrician's) (carpenter's) job.
(Translation - Why should I worry if nobody else can do their work, my job is done)
7. That's the size you ordered.
(Translation - Just because the guys at the plant can't read my writing does not mean that I am going to have it done right)
8. This part was discontinued last Friday.
(Translation - The boss said to get rid of this white elephant or else)
9. Everything but the money is extra.
(Translation - I gotta build up my retirement fund, doesn't everybody?)
10. I know what I am doing.
(Translation - Haven't got a clue how to do this, but I'll wing it)

Subscription rate adjustment

We're forced to increase the subscription rate. Our last change was January 1991 and we hoped that would be enough for some time, but this spring, with little warning Canada Post increased our postage rate by over 100%. We have no recourse but to pass this cost along. We will be honouring renewals at our older rate until November, so be sure to renew promptly! The new rates will be: 1 year $38.00, 2 years $72.00 (plus GST); USA and foreign 1 year $46.00, 2 years $88.00 (payable in US funds).